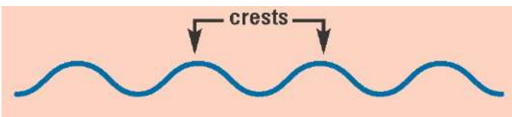
ALMANAC The Wave of the Present

PITCH

Perfect Pitch

Sound is a form of energy that travels in waves. If you could see sound, it would look like a Slinky™ stretched between two people and pushed backward and forward. Sometimes sound waves move slowly, with a long way between crests.



Sometimes the crests come at you thick and fast.

The difference has to do with the pitch of a sound. That's the same as a note, or sound, that's higher or lower than another. If you were to hum the lowest note you can and then look at it, you'd see that the crests on that sound wave are far apart. When that happens, we say the wave has a low frequency.

If you were to hum the highest note possible and could see the sound wave, you'd notice that the crests are a lot closer together. This wave has a high frequency and you are using a lot more energy to create it.

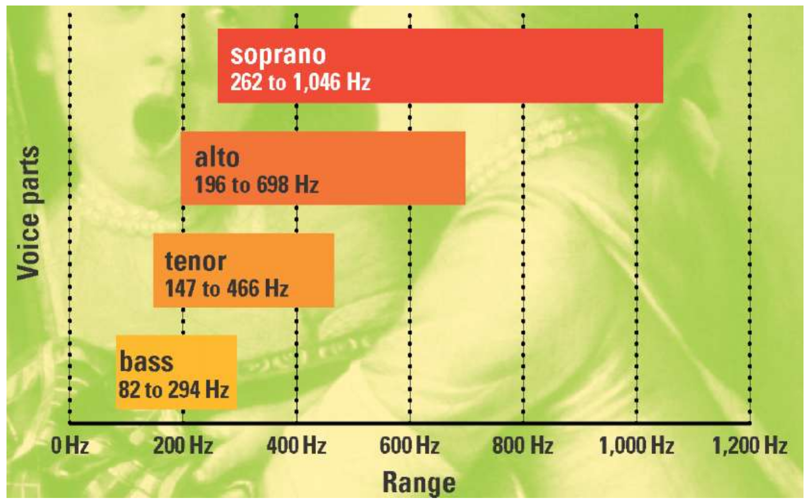
The closer the crests, the higher the frequency—and the higher the sound we hear. Frequency is measured in units called Hertz, which is abbreviated as Hz. To find Hertz, we look at how many crests pass a given point in one second. If 500 wave crests pass a point in one second, then we say the frequency is 500 Hz.

In the Right Range

Four musical voice parts range in frequency.

soprano (high female voice)
alto (low female voice)

tenor (high male voice)
bass (low male voice)



Fun Fact: Dolphins, bats, and grasshoppers can produce sounds more than 100 times higher than those of a soprano singing her highest note.

Hear, Hear!

Humans can hear sounds with frequencies as high as 20,000 Hz —high above anything anyone can sing. Impressive? Sure, but many animals hear much higher frequencies.

Animal	Lowest audible pitch	Highest audible pitch
Human	20 Hz	20,000 Hz
Dog	15 Hz	50,000 Hz
Cat	60 Hz	65,000 Hz
Dolphin	150 Hz	150,000 Hz
Bat	1,000 Hz	120,000 Hz

Helpful Hint: Don't bother singing to bats unless you're a soprano.

SPEED

The Need for Speed

Suppose you are standing at one end of a football field and your friend is at the other. If you shout your friend's name, the sound of your voice—the sound wave—travels from your mouth to your friend's ears. Do you think a third friend could run fast enough to follow the sound from your mouth to your friend's ears on the other side of the field? No way! On a warm day, sound waves travel close to 740 miles (1,191 km) an hour. Sounds like a lot, right? It is! It's 1,115 feet (340 m), or the length of four football fields, per second.

Break Through

The speed of sound waves also depends on where the sound is traveling. This chart shows how quickly sound travels through substances.

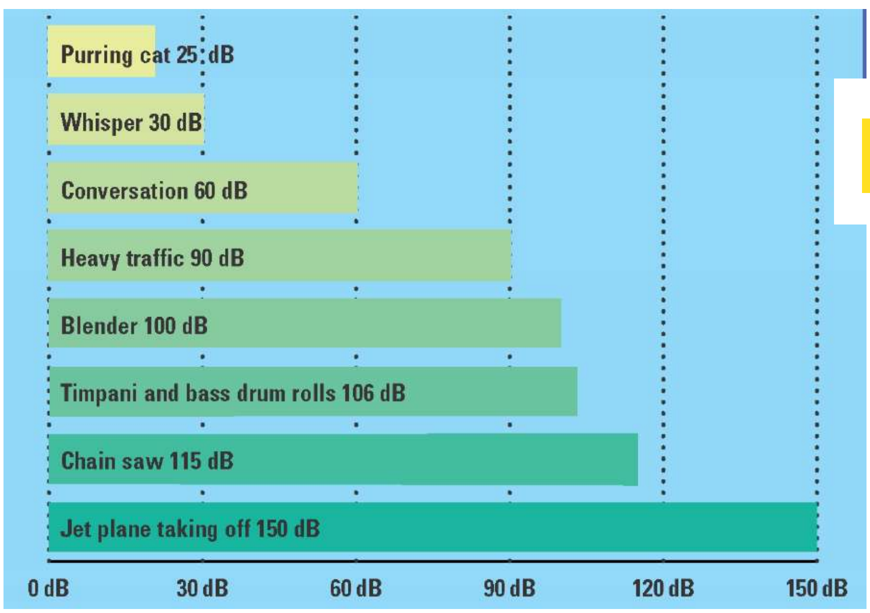
through air	340 m/sec
through alcohol	1,130 m/sec
through water	1,230 m/sec
through gold	3,240 m/sec
through steel	5,000 m/sec
through granite	6,000 m/sec

Obviously, air is pretty low on the list. But it beats outer space. Outer space is completely empty—we call it a vacuum—and sound can't form at all because there's nothing to carry the waves.

LOUDNESS

Turn That Thing Down!

The loudness of a sound is measured in decibels, abbreviated as dB. The higher the number, the louder the sound. It is a logarithmic scale in which each 10-point move up the scale is 10 times louder. For example, 30 dB is 10 times louder than 20 dB. A level of 0 dB is a sound that can barely be heard. You'll probably feel some discomfort or even pain listening to anything that's 120 dB or more.



Whatta Pain

Extended periods of listening to noise levels above 150 dB can actually cause deafness. But the decibel level drops as you move away from the source of a sound. A jet engine that blasts your eardrums at 140 dB when you're 98 feet (30 m) away is like 120 dB to someone 197 feet (60 m) away—and a tolerable 105 dB to someone who is 1,968 feet (600 m) from the runway.

Activity

ONE-HAND BAND Stretch a large rubber band between your thumb and index finger. Pluck it with your other hand. What's happening? Do the same activity with a smaller rubber band, perhaps one that's half the size. How does its sound compare to the larger band? Which do you think has a higher frequency? What might the sound waves coming from each look like? What do the results of this activity tell you about an adult's voice compared to a child's?